

**Interim Action Confirmation Report  
Site 39A - East Garrison Ranges  
Former Fort Ord, California**

Prepared for

**Department of the Army  
Corps of Engineers**  
Sacramento District  
1325 J Street  
Sacramento, California 95814-2922

HLA Project No. 23366 10071

Margaret L. Stemper

Margaret L. Stemper  
Senior Engineer

Edward J. Ticken

Edward J. Ticken, G.P. 922  
Principal Geophysicist

October 16, 1998



**Harding Lawson Associates**  
Engineering and Environmental Services  
90 Digital Drive  
Novato, California 94949 — (415) 883-0112

**Interim Action Confirmation Report  
Site 39A - East Garrison Ranges  
Former Fort Ord, California**

HLA Project No. 23366 10071

This document was prepared by Harding Lawson Associates at the direction of the U.S. Army Corps of Engineers (USACE) for the sole use of the USACE and the signatories of the Federal Facilities Agreement, including the Army, the U.S. Environmental Protection Agency, the Department of Toxic Substances Control (formerly, the Toxic Substances Control Program of the Department of Health Services), and the Regional Water Quality Control Board, Central Coast Region, the only intended beneficiaries of this work. No other party should rely on the information contained herein without prior written consent of the USACE and Army. This report and the interpretations, conclusions, and recommendations contained within are based, in part, on information presented in other documents that are cited in the text and listed in the references. Therefore, this report is subject to the limitations and qualifications presented in the referenced documents.

## CONTENTS

1 0 INTRODUCTION .....	1
2 0 PURPOSE AND SCOPE.....	2
3.0 SITE CHARACTERIZATION REPORT SUMMARY.....	3
3.1 Site Characterization.....	3
3.1.1 Field Program.....	3
3.1.2 Distribution Survey Results.....	4
3.1.3 Analytical Results .....	4
3.2 Screening Risk Evaluation .....	4
3.2.1 Potential Groundwater Impacts .....	5
3.2.2 Ecological Receptors .....	5
3.3 Conclusions and Recommendations.....	5
4.0 INTERIM ACTION SUMMARY .....	7
4.1 Approval Memorandum.....	7
4.2 IA Area Chemicals and Target Cleanup Concentrations.....	7
4.3 IA Excavation and Confirmation Samples.....	7
4.3.1 First Phase IA Activities.....	8
4.3.2 Second Phase IA Activities .....	9
4.3.3 Soil Removal and Disposal .....	10
5.0 EVALUATION OF RAOS FOR HUMAN HEALTH AND THE PROTECTION OF GROUNDWATER.....	11
6.0 CONCLUSIONS.....	13
7 0 REFERENCES .....	14

## TABLES

1	Site Characterization Activities
2	Maximum Detected Chemical Concentrations and Target Cleanup Concentrations
3	Estimated Excavation Dimensions and Number of Confirmation Samples - First Phase IA Excavations
4	Estimated Excavation Dimensions and Number of Confirmation Samples - Second Phase IA Excavations
5	Summary of IA Confirmation Samples
6	Detected Organic Compound Results in Final Confirmation Soil Samples
7	Detected Inorganic Compound Results in Final Confirmation Soil Samples
8	Comparison of Concentrations of Site-Related Chemicals with Preliminary Remediation Goals

## PLATES

1	Site Plan
2	Site Characterization Results - Study Area 1
3	Site Characterization Results - Study Area 2
4	Site Characterization Results (Distribution of Spent Ammunition) - Study Area 4
5	Site Characterization Results (Distribution of Clay Pigeon Fragments) - Study Area 4
6	Post-Remediation Confirmation Sample Locations - IA Areas 39A1 and 39A3

- 7 Post-Remediation Confirmation Sample Locations - IA Areas 39A2, 39A4, and 39A5
- 8 Post-Remediation Confirmation Sample Locations - IA Areas 39A6 and 39A7
- 9 Post-Remediation Confirmation Sample Locations - IA Areas 39A8A and 39A8E
- 10 Post-Remediation Confirmation Sample Locations - IA Areas 39A8B, 39A8C and 39A8D
- 11 Post-Remediation Confirmation Sample Locations - IA Areas 39A9A and 39A9B
- 12 Soil Sample Locations - Study Area 3 Target Bunker

## **APPENDIXES**

- A LABORATORY DATA - CONFIRMATION SAMPLES
- B CHAIN OF CUSTODY RECORDS
- C QUALITY CONTROL SUMMARY REPORT

## **DISTRIBUTION**

## 1.0 INTRODUCTION

The U.S. Army Corps of Engineers, Sacramento District (USACE), is conducting interim actions (IAs) at the former Fort Ord, California, in accordance with the *Interim Action Record of Decision, Contaminated Surface Soil Remediation, Fort Ord, California* (IAROD; Harding Lawson Associates (HLA), 1994a). The IAROD was signed by representatives of the U.S. Army (Army), the U.S. Environmental Protection Agency (EPA), and the California Environmental Protection Agency, Department of Toxic Substances Control [DTSC] and Central Coast Regional Water Quality Control Board(RWQCB).

IAs are being conducted at eligible sites as determined during the site characterization phase of the Fort Ord Remedial Investigation/Feasibility Study (RI/FS). IA sites by definition have limited surficial soil contamination that can be addressed by excavation of soil. IAs have been or will be implemented at sites with (1) a maximum depth of affected soil of 25 feet, and (2) a limited volume of affected soil, typically less than 5,500 cubic yards. The IAROD further describes the process and the criteria for identifying and approving potential IA areas for excavations.

This confirmation report presents the results of the IA performed at Site 39A, the East Garrison Firing Ranges at the former Fort Ord. The IA was described initially in the Army's *Approval Memorandum, Proposed Interim Action Excavation, Site 39A - East Garrison Ranges, Fort Ord, California* (HLA, 1997a). The IA was performed by Allied Technology Group, Inc. (ATG) and IT Corporation (IT), under contract to the USACE. Harding Lawson Associates (HLA) conducted the confirmation sampling and prepared this report under USACE Contract DACA05-96-D0007.

## **2.0 PURPOSE AND SCOPE**

This confirmation report presents the information necessary to evaluate whether the IA remedial action objectives (RAOs) outlined in the IAROD and the IA approval memorandum have been met for Site 39A. The RAOs for IA areas are to achieve an acceptable aggregate human health risk and to protect groundwater.

This confirmation report was prepared in accordance with the IAROD (*HLA, 1994a*) and includes the following: a summary of the initial

site characterization (Section 3.0), a summary of IA activities, including results of confirmation sampling and analysis (Section 4.0), an evaluation of RAOs for the protection of human health and groundwater quality based on the analytical results of the confirmation samples (Section 5.0), and conclusions regarding the achievement of RAOs at IA Areas 39A1 through 39A9 at Site 39A (Section 6.0). References cited in this report are listed in Section 7.0.

### 3.0 SITE CHARACTERIZATION REPORT SUMMARY

On May 16, 1997 the Army issued the *Draft Final Site Characterization Report, Site 39A - East Garrison Ranges, Fort Ord, California* (HLA, 1997b). An initial investigation (Phase I) was conducted between October 31 and November 16, 1994. The results of the Phase I investigation were reported in the *Draft Data Summary Report, Site Characterization, Site 39A, - East Garrison Ranges, Fort Ord, California* (HLA, 1994d). Following regulatory review of the Phase I results, additional site characterization activities (Phase II) were conducted in April and August, 1995 to address data gaps. The draft final site characterization report included a summary of all site characterization activities, as well as conclusions and recommendations for remedial actions at each of four study areas at Site 39A. The site characterization was performed to assess the environmental conditions associated with potential sources of contamination related to former site use (i.e., small arms firing ranges and a skeet range). Recommendations for further action at the site were based on an evaluation of potential health risks associated with site-related chemicals. The site characterization report is summarized in the following sections.

#### 3.1 Site Characterization

Site 39A, the Eastern Garrison Firing Ranges, is located in the northeastern portion of the former Fort Ord, on the western side of the East Garrison area (Plate 1). The site comprises three small-bore shooting ranges (EG-1, EG-2, and EG-3), a skeet range, and three former target bunkers associated with the ranges. A former tent camp area was located near the skeet range. Evidence of the former encampment consists of a series of asphalt-paved roadways. The range area is bounded by North Camp Street to the north, Barloy Canyon Road to the east, West Camp Street to the west, and a low topographic ridge to the south. Watkins Gate Road bisects the site and separates the skeet ranges to the north from the rest of the ranges to the south. The land including and surrounding the East Garrison Ranges is primarily vegetated dune sand. Surface topography at Site 39A generally slopes

toward the north from the ridge along the southern site boundary.

For site characterization purposes, Site 39A was divided into four study areas, as shown on Plate 1:

- Study Area 1 - Ranges EG-1 and EG-2
- Study Area 2 - Range EG-3
- Study Area 3 - Moving Target Range
- Study Area 4 - Skeet Range

Field activities were performed in accordance with procedures described in the *Draft Work Plan, Site Characterization, Site 39A, East Garrison Ranges, Fort Ord, California* (HLA, 1994c), the *Work Plan, Remedial Investigation/Feasibility Study, Fort Ord, California* (HLA, 1991a), the *Sampling and Analysis Plan, Part II: Quality Assurance Project Plan, Remedial Investigation/Feasibility Study, Fort Ord, California* (HLA, 1991b), and the site safety and health plans (EA, 1991 HLA, 1992). Site characterization activities and results are summarized below.

#### 3.1.1 Field Program

HLA performed field investigation tasks from October 31 through November 16, 1994 and in April and August, 1995. Tasks included visual surveys and test pit excavations to estimate the surface and subsurface distribution of spent ammunition and clay pigeons (skeet), and surface and subsurface soil sampling and analysis. Table 1 summarizes the specific investigation activities conducted in each of the study areas during both phases of investigation.

Forty-seven soil samples were collected and analyzed for one or more of the following: polynuclear aromatic hydrocarbons (PAHs) (considered representative of chemicals of concern present in clay pigeons); selected metals including antimony, arsenic, copper, lead, tin, and zinc (considered representative of chemicals present in spent small arms ammunition). All sampling locations, along

with the results of the visual surveys are shown on Plates 2, 3, 4, and 5.

The maximum depth explored during the investigation at Site 39A was 10 feet. Groundwater was not encountered during the field investigation; based on conditions in nearby areas as determined during RI activities, depth to water at Site 39A is estimated to be approximately 160 feet below ground surface (bgs).

### 3.1.2 Distribution Survey Results

#### *Distribution of Spent Ammunition*

Visual mapping of the surface distribution of spent ammunition along traverses and grids in Study Areas 1, 2, and 4 was used to develop zoned distribution summary maps for each of the areas, as shown on Plates 2, 3, 4, and 5. Results indicate that zones of moderate to heavy distribution (i.e., areas where spent ammunition is most likely to have impacted soil chemistry) occur as relatively small, discrete areas. In addition, results of the confirmation pit excavation and evaluation indicate that, with few exceptions, vertical distribution of spent ammunition is limited to the upper few inches of soil, even in areas of heavy surface coverage.

Visual mapping of surface distribution of ammunition in Study Area 3 was non-systematic because of dense tree and shrub coverage. Results were based on surveys of open areas only. Both vertical (from confirmation pits) and horizontal estimates of coverage indicate that distribution is very sparse (less than one bullet per square foot), and therefore, soil contamination as a result is unlikely in Study Area 3.

#### *Distribution of Clay Pigeons*

Distribution of clay pigeons in Study Area 4 was mapped as shown on Plate 5. Accumulations of clay pigeon fragments at the skeet range was categorized as heavy (six inches thick or greater), medium (less than six inches thick, but completely covering the surface), and light (fragments present, but not completely covering the surface). Accumulations of up to three feet in thickness were observed in some areas.

### 3.1.3 Analytical Results

The following is a summary of the analytical results for soil samples collected from the study areas. Based on the results of the site characterization, the site was divided into discrete Interim Action Areas (39A1 through A7, 39A8A through A8E, and 39A9A and 9B) as shown on Plates 6 through 11. Table 2 presents a summary of the maximum detected concentrations of those compounds present at concentrations above the preliminary remediation goals (PRGs) for each Interim Action Area.

#### *Metals*

The following metals were detected in one or more soil samples: antimony, arsenic, copper, lead, tin, and zinc. Only antimony and lead were detected above their respective TCCs (27 mg/kg and 240 mg/kg; arsenic was detected at concentrations exceeding the Fort Ord maximum background concentration for arsenic in surface soils (3.4 mg/kg; HLA, 1993a).

#### *PAHs*

Soil samples from Study Area 4 (skeet range) were submitted for analysis of PAHs. The following 12 PAHs were detected in one or more soil samples: acenaphthene, benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(ghi)perylene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, phenanthrene, and pyrene. Of these 12 compounds, only four (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, and indeno(1,2,3-cd)pyrene) were detected at concentrations exceeding their respective PRGs of 0.150 milligrams per kilogram (mg/kg), 0.015 mg/kg, 0.150 mg/kg, and 0.150 mg/kg.

### 3.2 Screening Risk Evaluation

HLA performed a screening risk evaluation (SRE), which consisted of the following:

- Comparing maximum detected concentrations of chemicals in soil to PRGs to evaluate the need for further action at the site
- Evaluating potential impacts to groundwater



- Summarizing an ecological risk assessment performed for the site.

The methodology and assumptions used to develop PRGs for the former Fort Ord were presented in HLA's *Draft Final Technical Memorandum, Preliminary Remediation Goals, Fort Ord, California* (HLA, 1994b). The PRGs represent soil concentrations considered to result in estimated daily doses (1) associated with an estimated 1-in-1-million probability that an exposed individual would develop cancer ( $10^{-6}$  cancer risk) or (2) expected to be without appreciable risk of deleterious noncancer health effects (hazard quotient less than 1).

PRGs for chemicals detected in soil at Site 39A were used to assess the need for further action at the site. Results indicated that: (1) the compounds detected in soil at Site 39A which may contribute substantially to a cancer risk estimate exceeding the RAO criterion are lead, arsenic, antimony, indeno(1,2,3-cd)pyrene, benzo(b)fluoranthene, benzo(a)pyrene, and benzo(a)anthracene, (2) no other chemicals contribute substantially to exceedances of RAO criterion, and (3) additional action at the site was necessary to mitigate potential health risks.

### **3.2.1 Potential Groundwater Impacts**

Potential impacts to groundwater from chemicals in soil were not assessed as part of the site characterization. Given the depth to groundwater at the site (approximately 160 feet bgs), and the presence of soil contaminants only in the very-near surface (less than three feet bgs), no potential impacts to groundwater are expected. In addition, as presented in the *Draft Technical Memorandum: Approach to Evaluating Potential Groundwater Quality Impacts, Fort Ord, California* (HLA, July 1993), cleanup of soils to the appropriate target cleanup concentrations (TCCs) is expected to prevent adverse impacts to groundwater due to leaching from soil.

### **3.2.2 Ecological Receptors**

A qualitative ecological assessment was completed and submitted as part of the Approval Memorandum (HLA, 1997a). Results indicated that proposed IA activities should

have no adverse impacts to ecological receptors and that achievement of RAOs following IA activities should eliminate potential impacts to ecological receptors from contaminants in soil.

## **3.3 Conclusions and Recommendations**

The following actions were recommended, based on investigation results for Site 39A.

### **Study Area 1 - Ranges EG-1 and EG-2**

Based on the visual survey of spent ammunition distribution in firing ranges EG-1 and EG-2, and the results of confirmation sampling and analysis, six individual areas had likely been impacted by past firing range activities and were recommended for remedial action. Lead and antimony were the contaminants of concern at this study area. With one exception, contamination was limited to surface soils (less than six inches deep). The following six areas met the criteria for soil excavation and removal under the Interim Action Record of Decision (IAROD) process (HLA, 1994a):

- Surface soil in front of the firing lines (to 20 feet downrange) at both Ranges EG-1 and EG-2;
- Backstop areas at both ranges (area mapped as moderate to heavy surface distribution); and
- Two narrow bands where surface coverage of up to 5 percent was observed; one band corresponds to the 50-meter target row at Range EG-1 and the other corresponds to the 25-meter target row at Range EG-2.

### **Study Area 2 - Range EG-3**

Based on the visual survey of spent ammunition distribution in firing range EG-3, two small areas near the center of the backstop had likely been impacted by past firing range activities and were recommended for remedial action under the IAROD process. Lead and antimony are considered the contaminants of concern at this study area.

### **Study Area 3 - Moving Target Range**

The visual survey and confirmation pit excavations indicated that usage of this range was relatively light and accumulation of spent ammunition was likely not sufficient to have impacted soil at the site. However, at the

request of the agencies, during the first phase of the IA, three soil samples were collected from the northern slope of the target bunker area where there was visual spent ammunition distribution and analyzed for metals to verify that metals were not present in soil above the cleanup levels (Plate 12). The results indicated concentrations of metals in the soil samples were below PRGs and TCCs (Sample 9746SA3010F, -011F, and -012F; Plate 12); therefore, no further action was recommended for this area

#### ***Study Area 4 - Skeet Range***

Based on the visual surveys of spent ammunition (lead shot) and clay pigeon distribution in the skeet range, and the results of confirmation sampling and analysis, two general areas had likely been impacted by past firing range activities and were recommended for remedial action. Lead and arsenic were the contaminants of concern for the areas impacted primarily by lead shot; PAHs were contaminants of concern for target areas impacted by clay pigeon accumulations. The following areas met the criteria for soil excavation and removal under the IAROD process:

#### ***Metals***

Surface soil in roughly half of the downrange portion of the skeet range was impacted by the presence of lead shot, as indicated by lead at concentrations above the PRG. Arsenic was also detected in soils from three locations; two surface and one subsurface (2.5 feet bgs), at concentrations greater than the maximum background concentration for arsenic in shallow soils at Fort Ord (3.4 mg/kg; HLA, 1993a).

#### ***PAHs***

PAHs were detected at concentrations exceeding PRGs at two locations, corresponding to areas where clay pigeon accumulations approached three feet in thickness or where finely powdered clay pigeon material had accumulated. PAH detections were limited to two soil samples collected at a depth of two feet bgs.

## 4.0 INTERIM ACTION SUMMARY

This section summarizes the IA activity at Site 39A, including preparation of an approval memorandum and collection and analysis of confirmation samples. IA excavations and confirmatory sampling was conducted in two phases. The first phase of the IA consisted of excavation of all IA Areas to the depth and extent recommended in the Approval Memorandum and was conducted between November and December 1997. A Second Phase IA excavation was conducted in July 1998 because residual soil contamination exceeded TCCs in some areas after the first phase was completed.

### 4.1 Approval Memorandum

Site characterization activities at Site 39A identified nine areas (designated 39A1 through 39A9) that met the criteria for IA excavations. These nine areas include eight areas containing lead-contaminated soil resulting from the presence of spent ammunition, and one area containing PAH-contaminated soil resulting from the presence of clay pigeons used at the skeet range. These areas are shown on Plates 6 (Areas 39A1 and 39A3), 7 (Areas 39A2, 39A4, and 39A5), 8 (Areas 39A6 and 39A7), 9 (Areas 39A8A and 39A8E), 10 (Areas 39A8B, 39A8C, and 39A8D), and 11 (Areas 39A9A, and 39A9B). In January 1997, the Army issued the *Approval Memorandum, Proposed Interim Action Excavations, Site 39A - East Garrison Ranges, Fort Ord, California (HLA, 1997a)*. The approval memorandum defined the approximate limits of the proposed IA excavations and detailed the screening process used to evaluate the IA. A site eligibility checklist that demonstrated the area's conformance with the IAROD criteria was included in the approval memorandum.

### 4.2 IA Area Chemicals and Target Cleanup Concentrations

The IAROD identified an RAO for IA areas as aggregate human health risk estimates of (1)  $10^{-6}$  excess cancer risk or lower and (2) a hazard index of 1 or less to address possible noncancer health effects. Chemical-specific PRGs developed in the Draft Final Technical

Memorandum (HLA, 1994b) and subsequent addenda were used to address this RAO. The PRGs were used to evaluate the contribution SRCs might make to aggregate area-related health risks. SRCs contributing significantly to aggregate health risks in excess of the RAO criteria may require cleanup. TCCs are developed for those chemicals contributing to exceedances of RAO criteria and represent soil concentrations that, if left in place, would achieve RAO criteria. The results of the SRE presented in HLA's Draft Final Site Characterization for Site 39A (HLA, 1997b) indicated that (1) lead, antimony, arsenic, indeno(1,2,3-cd)pyrene, benzo(b)fluoranthene, benzo(a)pyrene, and benzo(a)anthracene were detected in soil at one or more locations at concentrations that may contribute substantially to a cancer risk exceeding the RAO criterion and (2) other chemicals will not contribute substantially to exceedances of the RAO criteria. The maximum detected concentrations of chemicals exceeding PRGs at IA Areas 39A1 through 39A9, and the corresponding TCCs are presented in Table 2.

An evaluation of groundwater quality under the IAROD indicated that no significant impacts to groundwater are expected from the concentrations of chemicals detected at IA Areas 39A1 through 39A9. The approval memorandum confirmed the recommendation from the Draft Final Site Characterization for Site 39A stating that IA Areas 39A1 through 39A9 meet the criteria for early soil excavation established as part of the IAROD process at the former Fort Ord (HLA, 1994a).

### 4.3 IA Excavation and Confirmation Samples

IA activities at Site 39A were performed in accordance with the January 10, 1997 approval memorandum, as well as the Supplemental Scope of Work, Contract DACA05-97-D-0002, Task Order 003, Mod. 002, dated June 26, 1998. Soil excavation, stockpiling, and removal activities were conducted by ATC and IT, in accordance with the *Interim Action Excavation Work Plan, Site 39A (ATG, 1997)*. HLA conducted confirmatory sampling and analysis associated with the soil removal in accordance

with the *Draft Final Sampling and Analysis Plan, Interim Action Site 39A, Fort Ord Contaminated Soil Removal (HLA, 1997c)* and the *Sampling and Analysis Plan Addendum, Confirmatory Sampling - Phase II Interim Action Site 39A (HLA, 1998)*. Work at IA Areas 39A1 through 39A9 involved excavation of soil and spent ammunition and clay pigeons from the vicinity of the former firing ranges, as recommended in the Site Characterization report.

#### 4.3.1 First Phase IA Activities

The RI Sites ROD (Army, 1997) and its addenda (*Explanation of Significant Differences, Consolidation of Remediation Waste in a Corrective Action Management Unit [CAMU], Operable Unit 2 Landfill, Fort Ord, California, January 13, 1997 [ESD]*) designated the OU 2 Landfill at the former Fort Ord as a CAMU for placement of remediation wastes (e.g. soil) from RI and IA sites. The ESD also indicated spent ammunition should be removed and recycled prior to placement of the waste. Therefore, because the IA was based on cleanup to residential levels and spent ammunition existed within soils that would be placed at the OU 2 Landfill CAMU, spent ammunition was separated from soil as follows:

**Lead Shot** - Prior to IA excavation, lead shot present at the Skeet Range was removed by IT using vacuum equipment.

**Bullets** - Prior to placement in the OU 2 Landfill CAMU, bullets in soil from the small arms ranges were removed at IT's screening plant and recycled.

Initial (First Phase) IA excavations at Areas 39A1 through 39A9 were performed by ATG from November 10 through December 18, 1997. Interim Action Areas were delineated based on the observed distribution of ammunition and clay pigeons as well as analytical results from the site characterization. Approximate dimensions of the excavations are summarized in Table 3; the areas are outlined on Plates 6 through 11. Soils were removed mechanically to the specified depth and temporarily stockpiled at each location prior to consolidation and disposal. Some of the locations contained live oak trees; these areas were dug by hand to minimize damage to their root systems.

After the excavations were complete, a total of 131 confirmation samples were collected as indicated in Table 3. Confirmation sample locations are shown on Plates 6 through 11. The total number of confirmation samples was greater than that recommended in the IA approval memorandum because the total volume of excavated soil was greater than estimated. Duplicate and split samples were collected at the frequency specified in the Sampling and Analysis Plan for quality assurance/quality control (QA/QC) purposes. Four-point composite soil samples were also collected from soil stockpiles, at the frequency specified in the Sampling and Analysis Plan, to document the composition of soil disposed of at the OU 2 Landfill CAMU. Table 5 presents a summary of all samples collected as part of IA activities at Site 39A, and Tables 6 and 7 present summaries of chemical data for all final confirmation soil samples.

The confirmation samples collected from the Areas 39A1 through 39A7 excavations were analyzed for antimony and lead by EPA Test Method 6010B; Areas 39A8A through 39A8E excavations for arsenic and lead by EPA Test Method 6010B; and Area 39A9A and 39A9B excavations for PAHs by EPA Test Methods 8310.

One confirmatory sample each from two locations (39A3 and 39A5) contained lead at concentrations exceeding the TCCs (Plates 6, 7, and 8). Numerous soil confirmation samples from within the excavated area at 39A8A and most of area 39A8D contained arsenic and/or lead at concentrations exceeding the TCCs (Plates 9, 10, and 11). Multiple samples at both areas 39A9A and 39A9B contained PAHs at concentrations exceeding TCCs. All of these areas were identified as requiring further remediation in order to achieve RAOs.

Analytical results are summarized in Table 2. Table 5 presents a summary of all samples collected as part of IA activities, and Tables 6 and 7 present data for all final soil confirmation samples at Site 39A. Complete laboratory data reports and copies of the chain of custody records are presented in Appendixes A and B, respectively. Results of data validation performed on the confirmation samples are presented in Appendix C.

### 4.3.2 Second Phase IA Activities

Based on confirmation sample results from the First Phase IA activities (Section 4.3.1), additional excavation and confirmation sampling was required to achieve RAOs. Due to contractual procedures and wet weather conditions, the Second Phase activities were delayed until July, 1998. The Second Phase IA was conducted from July 14 through 30, 1998.

Based on discussions with and approval from the regulatory agencies in February 1998, overexcavation and collection of one confirmation sample was conducted from a 50 by 50 foot area for each isolated confirmation sample that exceeded a TCC. Areas that contained several adjacent confirmation sample results that exceeded TCCs were entirely overexcavated. Depths of overexcavations were based on analytical results. The following summarizes extent and depths of overexcavations for each IA Area:

- **Site 39A8A** - Overexcavation of eleven 50 by 50 foot areas to a depth of 1 foot below ground surface (bgs).
- **Site 39A9A** - Overexcavation of entire previously excavated area to a depth of one foot bgs; removal of oak tree in southwest corner and overexcavation by one foot bgs following removal.
- **Site 39A9D** - Overexcavation of entire previously excavated area to a depth of one foot bgs; removal of all oak trees and overexcavation by four feet bgs following removal.
- **Stockpile Areas** - Areas where contaminated soils and debris had been stockpiled over the winter outside IA Areas, or where stockpile covering and stabilization measures had been compromised since the First Phase IA (due, in part, to the extreme wet weather conditions during late 1997), were included for overexcavation and confirmation sampling during the Second Phase of IA activities. These areas (shown on Plates 6 through 11) were over excavated by 0.5 to 1 foot.

Approximate dimensions of the Second Phase excavations are summarized in Table 4; the areas are outlined on Plates 6 through 11. After the excavations were complete, a total of 48 confirmation samples were collected as indicated on Plates 6 through 11. Duplicate and split samples were collected at the frequency specified in the Sampling and Analysis Plan QA/QC purposes. Four-point composite soil samples were also collected from the Second Phase soil stockpiles for characterization purposes prior to placement at the OU 2 Landfill CAMU. Table 5 presents a summary of all samples collected as part of IA activities, and Tables 6 and 7 present data for all final soil confirmation samples at Site 39A.

The confirmation samples collected from the Areas 39A1 through 39A7 excavations were analyzed for antimony and lead by EPA Test Method 6010B; from Areas 39A8A through 39A8E excavations for arsenic and lead by EPA Test Method 6010B; and Areas 39A9A and 39A9B excavations for PAHs by EPA Test Method 8310. Following completion of Second Phase confirmation sampling and analysis, one sample location from beneath a former stockpile area (in the southeast corner of IA Site 39A9B (Plate 9) contained PAHs at concentrations exceeding their respective TCCs. An additional 15 cubic yards of soil (a 20 by 20 foot area to a depth of 1 foot bgs) was removed from the vicinity of sample 9831LA9B056F (Plate 9) by IT on September 24, 1998 and a confirmation sample was collected and analyzed for PAHs. The confirmation sample result indicated concentrations of PAHs were below TCCs.

Analytical results are summarized in Table 2. Table 5 presents a summary of all samples collected as part of IA activities, and Tables 6 and 7 present data for all final soil confirmation samples at Site 39A. Confirmation results from all areas sampled as part of the Second Phase of the IA were below their respective TCCs. Complete laboratory data reports and copies of the chain of custody records are presented in Appendixes A and B, respectively. Results of data validation performed on the confirmation samples are presented in Appendix C.

#### **4.3.3 Soil Removal and Disposal**

During the First Phase of the IA, approximately 5,500 cy of soil was removed from the IA Areas 39A1 through 39A9 and was temporarily stockpiled at each IA Area. The stockpiled soil was then transported to the former Fort Ord OU 2 landfill for placement in the CAMU as described previously. Four-point composite samples were collected from the stockpiled soils (as described in the sampling and analysis plans) to provide documentation and

characterization of IA soils placed in the CAMU.

In February 1998, the regulatory agencies approved overexcavation of the remaining soil, and approximately 1,000 cy of soil was removed during Second Phase IA excavation activities. These soils, along with potentially contaminated vegetation and plastic sheeting from stockpile areas, were taken directly to the former Fort Ord CAMU as fill material. No oak tree debris was transported to the CAMU, as directed by the USACE.

## 5.0 EVALUATION OF RAOs FOR HUMAN HEALTH AND THE PROTECTION OF GROUNDWATER

Analytical results of confirmation soil samples were evaluated to determine whether RAOs addressing the protection of human health and groundwater have been achieved at IA Areas 39A1 through 39A9. A total of 179 confirmation soil samples (131 during First Phase and 48 during Second Phase) were collected from excavations at IA Site 39A. Results of chemical analyses of these samples represent chemical concentrations in soil remaining after the IA excavations and soil removal. Analytical results for the duplicate samples and composite samples from the stockpiles were used for QC and waste disposal purposes, respectively, and were not included in the evaluation of RAOs. To determine whether RAOs have been achieved, maximum concentrations of chemicals were compared to TCCs, as discussed below. As stated in the approval memorandum, PRGs were selected to be TCCs for IA Areas 39A1 through 39A9.

The primary rationale for the development of IA RAOs is the reduction of risks to human health associated with chemicals at an IA area. Achievement of RAOs requires establishment of allowable concentrations (i.e., TCCs) of chemicals in soil. Soil having allowable concentrations of chemicals, if left in place, would not pose unacceptable risks to future residents or users of the IA area and would not adversely impact groundwater quality. TCCs are considered only for those chemicals contributing to exceedances of RAO criteria.

In the approval memorandum for the IA excavations at Site 39A, results of the SRE indicated that the RAO criteria addressing groundwater quality would be achieved at Site 39A by soil removal. To determine whether RAOs had been achieved, the maximum concentrations detected in confirmation soil samples collected during First Phase IA activities after soil removal were compared to the TCCs for their respective chemicals. As shown on Plates 6 through 11, overexcavation and resampling for lead, arsenic, antimony, and PAHs was conducted because concentrations in soil were above their respective TCCs at several locations after the First Phase IA. Additional excavation was

subsequently performed (Second Phase IA), and additional confirmation samples were collected. No chemicals were detected above the detection limits in the final confirmation samples collected from IA Sites 39A1 through 39A9 during the Second Phase IA.

A health risk evaluation was performed to determine whether RAOs addressing human health risks and protection of groundwater have been achieved at IA Site 39A. A total of 179 samples were collected at IA Site 39A. Results of chemical analyses for final soil confirmation samples represent residual chemical concentrations in soil remaining after the IA. A comparison of the maximum detected concentration of site-related chemicals detected in final confirmation samples at the IA area to PRGs is presented in Table 8, and discussed below.

The primary rationale for the development of interim action RAOs is the reduction of risks to human health associated with chemicals at an IA area. Achievement of RAOs requires establishment of allowable concentrations (i.e., TCCs) of chemicals in surface soil. Soil having allowable concentrations of chemicals, if left in place, would not pose unacceptable risks to future residents or users of the IA area, and would not adversely impact groundwater. In the Approval Memorandum for the Site 39A excavation, TCCs were identified for seven chemicals: lead (240 mg/kg), antimony (27 mg/kg), arsenic (2.87 mg/kg), benzo(a)pyrene (0.015 mg/kg), benzo(a)anthracene (0.15 mg/kg), benzo(b)fluoranthene (0.15 mg/kg) and indeno(1,2,3-cd)pyrene (0.15 mg/kg). TCCs were identified for these chemicals to address human health risks.

To determine whether RAOs have been achieved, residual chemical concentrations were compared to PRGs and to TCCs established for IA Site 39A. As shown in Table 2, maximum detected concentrations of site-related chemicals are all well below PRGs, and RAO criteria of aggregate human health risk estimates of (1)  $10^{-6}$  excess cancer risk or lower and (2) a hazard index of one or less to address

possible noncancer health effects have been achieved.

The above evaluation of RAOs considers exposures to those chemicals for which TCCs were developed. To further confirm that the RAO criterion addressing human health risks has been achieved, the maximum detected concentration of all potential SRCs detected in confirmation soil samples from site 39A were compared to PRGs. As shown in Table 8, the maximum detected concentrations of each chemical is below both the cancer and noncancer PRGs, and the overall sum ratios are less than 1. Therefore, the RAO criterion for the protection of human health has been achieved at LA Site 39A.



## 6.0 CONCLUSIONS

Results of the confirmation sampling indicate that soils containing lead, antimony, arsenic, indeno(1,2,3-cd)pyrene, benzo(b)fluoranthene, benzo(a)pyrene, and benzo(a)anthracene above their respective TCCs have been removed. No other chemicals were identified for cleanup in the IA approval memorandum (HLA, 1997a). Therefore, based on previous characterization, the SRE, results of the confirmation sampling, and the ecological risk evaluation, no further threat to human health, the environment, or groundwater is anticipated at this site and no further investigation or remediation is recommended.

## 7.0 REFERENCES

- Alliance Technology Group, Inc. (ATG), 1997 *Interim Action Excavation Work Plan, Site 39A*, Revision 1. October.
- EA Engineering, Sciences, and Technology (EA), 1991. *Basewide Remedial Investigation/Feasibility Study, Fort Ord, California, Vol. 4, Site Safety and Health Plan*. Draft final. Prepared for Omaha USACE.
- Harding Lawson Associates (HLA), 1991a. *Work Plan, Remedial Investigation/Feasibility Study, Fort Ord, California*. Prepared for Sacramento USACE. December 2.
- \_\_\_\_\_, 1991b. *Sampling and Analysis Plan, Remedial Investigation/Feasibility Study, Fort Ord, California*. Prepared for Sacramento USACE. December 12.
- \_\_\_\_\_, 1992. *Site Safety and Health Plan, Addendum, Fort Ord, California*. Prepared for Sacramento USACE.
- \_\_\_\_\_, 1993a. *Draft Final Basewide Background Soil Investigation, Fort Ord, California*. March 15.
- \_\_\_\_\_, 1993b. *Draft Technical Memorandum: Approach to Evaluating Potential Groundwater Quality Impacts, Fort Ord, California*. July.
- \_\_\_\_\_, 1994a. *Interim Action Record of Decision, Contaminated Surface Soil Remediation, Fort Ord, California*. February 23.
- \_\_\_\_\_, 1994b. *Draft Final Technical Memorandum, Preliminary Remediation Goals, Fort Ord, California*. June 24.
- \_\_\_\_\_, 1994c. *Draft Work Plan, Site Characterization, Site 39A - East Garrison Ranges, Fort Ord, California*.
- \_\_\_\_\_, 1994d. *Draft Data Summary Report, Site 39A - East Garrison Ranges, Fort Ord, California*.
- \_\_\_\_\_, 1997a. *Approval Memorandum, Proposed Interim Action Excavations, Site 39A-East Garrison Ranges, Fort Ord, California*. January 10.
- \_\_\_\_\_, 1997b. *Draft Final Site Characterization, Site 39A-East Garrison Ranges, Fort Ord, California*. May 16.
- \_\_\_\_\_, 1997c. *Draft Final Sampling and Analysis Plan, Interim Action Site 39A, Fort Ord Contaminated Soil Removal, Fort Ord, California*. November 14.
- \_\_\_\_\_, 1998. *Sampling and Analysis Plan Addendum, Confirmatory Sampling - Phase II Interim Action Site 39A, Fort Ord Contaminated Soil Removal, Fort Ord, California*. July 7.